Random Thoughts . . .

THE MURKY CRYSTAL BALL

Richard M. Felder

In 1968 I was in the second year of a two-year postdoc at Brookhaven National Laboratory, looking for a faculty position. I got an invitation to apply for a vacant position at North Carolina State University, and even though I believed that civilization as we know it pretty much ended south of New Jersey, I went to Raleigh for an interview. In my first morning on campus I was with Jim Ferrell, the Department Head, chatting about my goals and interests and finding out what I could about life in the wilderness, when an elderly gentleman walked into the office and Jim said "Rich, I'd like you to meet Warren McCabe."

In my mind Warren McCabe wasn't a real person—he was the legend who co-created a graphical method for designing distillation columns back in ancient times (actually, 1925). It felt like Jim was introducing me to George Washington or Socrates. I bit my tongue before blurting out "Is he still alive?" and responded with one of the usual pleasantries.

I just looked McCabe up on the Web and learned that he was born in 1899. I did the math and figured out that he was 69 years old when I met him that day. I was born in 1939. Do the math. I'm going to take a nap now. Talk among yourselves for awhile.

OK, I'm back. In 1968, I was 29 years old. If you had asked 29-year-old Warren McCabe to predict what an engineering professor's life would be like in, say, 15 years, he would probably have guessed that it wouldn't be all that different and he would have been right. If you asked 29-year-old Richard Felder to make predictions in 1968 about what 1983 would be like, it would have been a different story. There were computers in 1968, but that was it for technology. We were all still doing our basic calculations with slide rules—I didn't get my HP-35 until 1972. E-mail began in 1972. The term "word processing" was used for the first time in 1974, and a few years later the first word processors that weren't just add-ons to typewriters appeared. (If I've lost you, feel free to Google "typewriter.") The first modern spreadsheet program (VisiCalc) and the first commercial antecedent of PowerPoint (BRUNO) both appeared in 1979, and the IBM PC came along in 1981. There were Internet-like connections between some universities starting in the early 1970s, and the word "Internet" showed up in 1982. Good luck predicting all that in 1968.

But just to prove that wisdom doesn't necessarily come with extreme age, I'm going to make a few predictions about engineering education 10 years from now—long enough for the future to be far from predictable, and short enough to give me a fighting chance of still being around to be humiliated when I turn out to be wrong about everything.

- *Goodbye, straight lectures. Hello, flipped classrooms.*

In 10 years you'll still be able to walk down the hall of an engineering school building, poke your head into a random classroom, and see an instructor showing PowerPoint slides to a nearly catatonic class. The odds that that's what you'll see will be a lot lower, though. You're more likely to see students clustered in groups working on an assignment or project, or sitting over a tablet or laptop computer viewing a video or simulation or multimedia tutorial or solving a problem or

Richard M. Felder *is Hoechst Celanese Professor Emeritus of Chemical Engineering at North Carolina State University. He is co-author of* Elementary Principles of Chemical Processes *(Wiley, 2005) and numerous articles on chemical process engineering and engineering and science education, and regularly presents workshops on effective college teaching at campuses and conferences around the world. Many of his publications can be seen at <www.ncsu.edu/effective_teaching>.*

writing a report. Their instructor will have discovered that her students could learn the straightforward course content themselves from well-designed online materials and then learn the hard stuff actively in class, and so she flipped her class. By 2024, most classes that aren't fully online will be flipped.

• *Goodbye, math-heavy curriculum.*

The math that occupies such a large part of most current undergraduate engineering curricula—three semesters of calculus, analytical solutions of boundary-value problems, Laplace and Fourier-domain analysis, tensor calculus, and so on—will migrate primarily to graduate and undergraduate honors courses. It will be replaced by training in more of the skills most engineers will actually need in coming decades—critical and creative thinking, economics and business, and those "soft" skills like communications and teamwork that ABET muscled into the curriculum in 2001.

• *Goodbye, textbooks.*

Forget about 10 years from now—a 700-page book that costs students upwards of $200 is already a dinosaur. (I freely admit that I'm currently involved in creating the fourth edition of a stegosaurus.) A $50 electronic version of that dinosaur with pages viewed and turned on a computer screen is also a dinosaur, perhaps from a later period but equally destined for extinction. The future—the near future, not the distant future—belongs to interactive instructional technology that makes students active participants in the learning experience and not just passive recipients of information.

• *Hello, faculty development.*

The absurdity of turning new faculty members loose to start and build research programs and teach without so much as five seconds of guidance on how to do those things will finally dawn on administrators. Many schools will start providing discipline-based faculty training and mentoring, cutting a full three years from the average time their new faculty members take to reach their potential for research productivity and teaching effectiveness. (That development has already started to take place, and the outcome isn't speculation—it's already been demonstrated.)

• *Hello, corporate university model. Goodbye, tenure.*

A large and growing number of universities now view themselves as businesses and unhesitatingly sacrifice educational quality for short-term revenues. That trend will continue. Retiring tenured professors will be increasingly replaced by contracted instructors. Lectures will be delivered to larger and larger classes by fewer and fewer professors, supplemented by recitations led by those contracted instructors and graduate students. The resulting cost savings will mainly go to raise top administrators' salaries and benefits and hire more associate and assistant provosts and deans. I hope this gloomy picture is an unrealistic worst-case scenario, but I would still bet on it.

• *Hello, MOOCs.*

It's getting popular to write off MOOCs (massive open online courses) these days. In journal articles and white papers and faculty meetings, pundits assure us that MOOCs are just a fad and will disappear within a few years.

Wrong! The technology for presenting online courses and getting online students actively and interactively engaged is rapidly improving. In the coming years the most skillful and charismatic instructors in the world will collaborate with expert software designers to create dynamic lecture clips, animations, simulations, interactive tutorials, and virtual labs run by virtual student teams. As those developments take place, more and more degrees will be awarded by accredited MOOC-based and other online programs for a fraction of the cost charged by brick-and-mortar campuses, and more and more students will vote for the onlines with their feet.

• *Goodbye, many traditional universities—but not all of them. (Hopefully, not yours.)*

Many traditional schools will continue to follow the corporate model described two bullet points ago. They will not be able to compete for students with those well-designed, well-implemented, and much less costly online programs, and some of them will no longer be with us in 10 years. Other schools will take as their primary mission equipping students to function as skilled and creative professionals, critical thinkers, and well-educated citizens. Those schools will hire faculty capable of fulfilling that mission; give them reasonable facilities to teach in (goodbye, 700-student classrooms); and provide recognition and rewards to the instructors who succeed. They will be able to claim and prove that they provide a better education than online programs will ever be able to provide, and they will still be here in 10 years and in the decades that follow. I'd bet heavily on this one. ❏

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